Design of Intelligent Electronic Meters Based on GPRS

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Abstract

The essay first sets forth a general design scheme about software and hardware circuits of intelligent electronic meters based on GPRS, then separately designs energy measurement chips, GPRS communication modules, power units and a flow chart of partial main programs in the systematic design scheme.

Keywords: GPRS communication module, electronic meter, AT89S52 single chip

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1. Introduction

In recent years, with the advancement of science and technology and the development of city modernization, the electronic power industry in our country steps into the express lane of unprecedentedly rapid development. At the same time, our country implements the policy of "a house, an electric city meter". Original manual meter-reading work requires workers to go to each house, heavy workload, high labor intensity, low efficiency and inconvenience to residents' daily life, it exposes a lot of deficiencies and disadvantages, so traditional manual meter-reading work can fit the present situation [1]. In order to make resident's power using mode more rationalization and higher efficiency and improve management effectiveness of power supply branch, it is necessary to reform tradition meter-reading working mode in order to satisfy rapid development of our country's economy and society. At present, the technology of meter reading in our country includes manual work, RS485bus, IrDA and power line carrier, etc. Among them, the technologies which are mature and more widely adopted are RS485 bus and infrared meter-reading techniques. But RS485 bus needs wiring and only can be carried out in small areas; the infrared meter reading technique also needs workers to read meters on the spot; power line carrier can only be used in a small area less then 1,000 meters and its technique also exists some problems. Under such circumstance, people are in urgent need of multifunctional intelligent electronic meters. So the essay presents the design and research of intelligent electronic meters based on GPRS to achieve remote, read-time, and automatic meter reading [2].

2. GPRS Remote Meter-Reading System

GPRS remote meter-reading system is an automatic electric power management meter-reading system based on GPRS techniques. It is based on GPRS service platform of Mobile Communication Corporation to construct remote electric power meter-reading system. It can use IP supplied by GPRS mobile network system to realize wireless transmission of ammeter data. It has a series of virtues, such as timely data collection, remote control and management, small investment, short construction period, large transmission capacity and large meter-reading capacity, etc., which have been widely valued by scholars at home and abroad, and become the hot and difficult point of present research [3].

3. General Design Scheme

The general design scheme of intelligent electronic meters based on GPRS is shown in Figure 1. the design scheme takes the AT89S52 as the core to design measurement chips, the

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memory cell EEPROM, communication units, display units, power supply units and sample circuits of voltage of voltage and electric current. GPRS adopts M590 module produced by Shenzhen Yongfang Science and Technology Ltd. The module adopts solution of Infineon Tech T880 single chip, supplies the function of SMS and data and has internationally certificated GPRS R4 agreement and the serial port CMUX function; the metering unit of electrical energy adopts specified CS5460A electrical energy metering-unit produced by America Cirrus Logic Company to endure accuracy of electrical energy metering; MCU is the core component of this intelligent electronic meter design, and it adopts the specified AT89S52 single chip which has the characteristics of high Anti-jamming, low power consumption as the major controller to make the system operation steady and reliable; the memory unit EEPROM is used to store active and reactive power electricity of intelligent electronic meters; RS485 and infrared ports are mainly applied to local communication [4]. Simultaneously in order to display and watch conveniently, the design uses liquid crystal display which can show operational state, electric quantities of intelligent electronic meters and error information/failure message in real time.

4. Design of Hardware Circuit

The MCU adopted in the essay is the more advanced AT89S52 single chip at present; its structure chart of pins is shown as Figure 2. AT89S52 produced through Atmel Company’s highly dense, nom-vulnerable memory techniques is a kind of low power consumption, high performance index, 8 bit microcontroller which is compatible with 80C51 chip. At the same time, it has 8k byte, programming allowable flash memory, smart eight-bit CPU, 2 bit I/O port line, 256 byte RAM, 2 data pointers, watch dog timer, three 16 bit timer/counter, full duplex serial port, crystal oscillator, clock circuit and one six-vector, two-level interrupt structure. Additionally, AT89S52 is in idle mode, the CPU stops work, but timer/counter, RAM, port line, blackout can still work; when chip AT89S52 is in power down modes, chip AT89S52 cannot work until a blackout or hardware resets.

CS5460A energy measure chip produced by America Cirrus Logic Company is the energy measurement chip of uniphase bidirectional power. Its internal pin assignment was shown as the following Figure 3. It includes active power calculation engine, 2 programmable gain amplifiers, and 2 high pass filter, etc. which can measure and calculate active electric energy, instantaneous power, supple data samples of instantaneous voltage/current/power, and develop uniphase two-wire or three wire electric meters. CS5460A can use diverter or sensor to measure electric current, divider resistance and resistance sensor to measure voltage. At the same time, it has the b bidirectional serial interface to communicate with microcontrollers; output pulse frequency is in proportionate to active power. When CS 5460A works, it does not need add extra microcontroller, so when electric meters are used to measure electric energy in houses or businesses on a large scale, the cost of electric meters will be largely reduced.

GPRS communication module adopts the M590 module produced by Shengzhen Youfang Science and Technology Ltd. This module adopts solution program of single chip Infineon Tech 7880 to supply message and data and has GPRS R agreement which are universally certificated, the serial interface, CMUX function and SAIC elimination technology of single-antenna obstacles to solve the problem of receiving signals in remote mountainous areas.

The circuit of power units is shown as shown as Figure 4. In this design, electric meters adopt linear DC regulated power supplies. They firstly turn AC voltages from power grid into pulse DC voltage through transformers and stable bridge rectifier circuit, and then change into continuously adjustable output voltage of amplitude through filter circuits. Filter capacitors of input terminal C1 and C2 can eliminate disturbing impulse of power units caused by inductive effect and capacitor C3 is designed to reduce ripple voltage of R2’s two ends, protective diodes VD1 and VD2 are designed to prevent reverse voltage from penetrating voltage regulators. From the designed circuits we can know: when resistance of adjustable resistor R2 is regulated size of LM317 output voltage can be adjust; simultaneously when the resistance of R is adjusted, because the voltage add on the two ends of LED change, the luminance will change with increase and decrease of LED R2’s resistance. The spare battery is prepared to prevent electronic meters from loss of power when the AC power supply suddenly breaks down. When
the detection chip of the power supply tests the power failure of electronic meters, the spare battery will supply power immediately.

5. Results and Analysis

The design of software sector is shown as Figure 5. The essay adopts the module design according to different function to define mutual coordinate relationship. After the initialization of the system, the data stored in EEPROM memory cell of electric meters begins to be read, and configured; after configuration, the data in energy measurement chip CS 5460A is read and TCP link is set to convey data which are display on the screen at last. At the same time, overpressure detector and over-current detection of voltage/current sample is designed. The whole design employs the method of sequential execution and carries out scanning each custom mark bit and checking whether movement is needed. If needed, step into corresponding program to operate [5-7].

Figure 1. General scheme of intelligent electric meters based on GPRS

Figure 2. Structure chart of AT89S52 pins
Figure 3. Internal pin assignment of CS5460A

Figure 4. Circuit schematics of power units
6. Conclusion

Through the design and research of intelligent electric meters based on GPRS, the essay introduced the pins of AT89S52 single chip and their functions and designed circuits of energy measurement chip, GPRS communication module, power units and other main hardware and main programs flow chart of software. These supply theoretical support for further related research.
Conflict Of Interest

The author confirms that this article content has no conflict of interest.

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References